

# EX23.1

## TORONTO TRANSIT COMMISSION (TTC) SCARBOROUGH SUBWAY EXTENSION

### McCOWAN ALIGNMENT – FOOTLONG STATION DESIGN OPTIONS TTC ESTIMATE PEER REVIEW

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Hanscomb

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## Executive Summary

### Introduction

Hanscomb Limited has been retained by BT Engineering to provide an Independent Estimate Peer Review of the Toronto Transit Commission (TTC) Order of Magnitude Estimate (OME) for the proposed Scarborough Subway Extension Project. The TTC's OME was prepared based on 2% to 5% complete documentation.

Our Scope of Services is comprised of two phases:

Phase 1: Review all documents provided, specifically:

- Conceptual Design prepared by AECOM for the Subway Station and Bus Terminal
- Meetings with TTC Project Management, TTC Estimating and Hatch
- TTC's Order of Magnitude Estimate for the McCowan Alignment - Footlong Station Option
- Any additional information provided by TTC and Hatch Mott MacDonald

Phase 2: Based on Phase 1, prepare an independent peer review report in both XLS format and written report as requested. Our methodology has been to prepare Order of Magnitude Estimates where we are able to and comment on what we cannot easily estimate, based on our experience as well as access to other available TTC projects cost data.

The key issues arising from Hanscomb's independent peer review of TTC's OME are summarized in XLS format in chart form. It is recommended that our comments be reviewed and resolved by the project team to ensure that the total project budget is complete and a fair representation of the expected project cost.

### TTC Estimate

Table 1: TTC's Order of Magnitude Estimate (OME) Main Summary in 2015 dollars:

Item Description	Total 2015 \$
SCC Station, Bus Platforms, Site Development & Utilities	\$425,829,352
Running Structures & Special Structures	\$681,651,075
Utilities - Running Structures	\$10,936,687
Operating Systems	\$195,897,669
<b>Total Raw Construction Cost in 2015\$</b>	<b>\$1,314,314,783</b>
Engineering & Management	\$328,578,696
Contingency Allowance	\$492,868,043
Extra-Over Risk - Single Bore Tunnel	\$0
Property/Easements - Allowance	\$108,242,759
STC Mall Lost Revenue Impact due to Parking / construction disturbance	\$1,000,000
Revenue Vehicles & ATC Equipping (TR Cars)	\$130,683,021
HST Rebate (11.76%)	(\$202,855,105)
<b>Total Estimated Cost in 2015 \$</b>	<b>\$2,172,832,196</b>

## Executive Summary

Table 2: Hanscomb has summarized TTC's OME in the following categories:

	Scarborough City Centre Subway Station	Scarborough Bus Terminal	Scarborough Centre Site Works Incl. Roads, Bridges & Utilities	Substation	Running Structure	Operating System	Total
SCC Station	\$ 228,957,670						\$ 228,957,670
Bus Terminal		\$ 101,957,873					\$ 101,957,873
Site Development inc. roads, bridges & utilities			\$ 79,855,436				\$ 79,855,436
Substation				\$ 15,058,374			\$ 15,058,374
Running Structure (Tunnel) inc. Special Structures (EBBs, shafts, etc.) & utilities					\$ 692,587,762		\$ 692,587,762
Operating System						\$ 195,897,669	\$ 195,897,669
<b>Total Construction Cost</b>	<b>\$ 228,957,670</b>	<b>\$ 101,957,873</b>	<b>\$ 79,855,436</b>	<b>\$ 15,058,374</b>	<b>\$ 692,587,762</b>	<b>\$ 195,897,669</b>	<b>\$ 1,314,314,783</b>
Engineering & Management	25% \$ 57,239,417	\$ 25,489,468	\$ 19,963,859	\$ 3,764,594	\$ 173,146,941	\$ 48,974,417	\$ 328,578,696
Contingency Allowance	30% \$ 85,859,126	\$ 38,234,202	\$ 29,945,789	\$ 5,646,890	\$ 259,720,411	\$ 73,461,626	\$ 492,868,044
Property/Easements	Sum						\$ 108,242,759
STC Mall lost revenue	Sum						\$ 1,000,000
Purchase Vehicles & ATC	Sum						\$ 130,683,021
HST Rebate(10.1043%)	Sum						-\$ 202,855,105
<b>Total Project Cost</b>	<b>\$ 372,056,213</b>	<b>\$ 165,681,544</b>	<b>\$ 129,765,084</b>	<b>24,469,858</b>	<b>\$ 1,125,455,113</b>	<b>\$ 318,333,712</b>	<b>\$ 2,172,832,197</b>

## Conclusions

Hanscomb's review of the documentation provided along with the OME prepared by TTC confirms that the scope of work aligns generally with the OME.

Based on our findings, the potential variance equates to an increase of approximately \$122 million which is 5.7% higher than TTC's OME. We believe this OME is fair and reasonable for the stage of the project development undertaken at the time of the estimate. Our variance/adjusted amounts incorporate some fluid cost adjustments that may require further discussion with TTC Project Management and Estimating.

Our adjustments are summarized below by general WBS section:

- Subway station and bus terminal adjustments totalling a negligible add;
- No cost adjustment to substation buildings;
- Add for against running structure;
- Add for incomplete tender documentation;
- Add for management reserve; and
- Add for incurred business losses.

## Executive Summary

The following are the limitations of our Estimate Peer Review:

- Based on our best judgment, we have reviewed the overall cost of the tunnel on a track metre basis, and we feel that the unit rate is reasonable based on the input from TTC and Hatch.
- For TTC system-wide elements, we again have limited expertise and are relying on the TTC OME and input received from TTC for the TYSSE project as being reasonable and appropriate.

It should be noted that the Toronto York Spadina Subway Extension (TYSSE) project cost data was not made completely available to us for this review as the project is on-going.

In general, the TTC OME is valid and appropriate for this stage of the project development (2% to 5% complete documentation). In our opinion, if the scope does not change, this is a valid estimate in 2015 dollars. Valid order of magnitude estimates (OMEs) typically anticipate a level of accuracy of -20% and +50% (reference AACE 2016 [www.aacei.org/toc/toc\\_18R-97.pdf](http://www.aacei.org/toc/toc_18R-97.pdf)) assuming that the project scope does not change. However, if the scope changes, as with any and all construction budgets, the ability to fund and absorb the cost of scope changes is often problematic.

## 1. Overview

### 1.1 Purpose

This Independent Estimate Peer Review of the TTC OME for the McCowan Alignment - Footlong Option has been prepared by Hanscomb Limited as an independent review in part to ensure that cost projections for this large capital project are fair and reasonable and that the project can be completed on budget. Further, a Value Engineering workshop had been conducted to identify possible cost mitigation items.

To this end, this report provides comment on the following:

- Alignment between project scope and the project estimate;
- TTC OME for the McCowan Alignment - Footlong Station Option;
- Unit prices and alignment with expected market pricing;
- Project engineering and management fee and expenses allowances;
- General Contractor's requirements and fees;
- Project contingency;
- Cursory check of quantities for reasonableness; and
- Escalation contingency.

### 1.2 Project Description

This project includes construction of a new subway extension from Kennedy Station to Scarborough Town Centre (6.24 km). The TTC have explored a number of alignment corridors, at this juncture the McCowan Alignment Revision J controlled with an at-grade bus terminal is the preferred alignment and was the basis for the TTC budget estimate. Additional alignments may still be under review.

The scope of this project includes the following:

- 10.7m diameter single bore tunnel;
- New 3-storey subway station including six tunnels vent fans;
- Single level 30 bay bus station at a lower level with a green vegetated roof;
- Three substation buildings;
- Eight emergency exit buildings (EEB);
- Launch shaft and working shaft;
- Fan plants (3) beyond the station building;
- Vehicles with running structures; and
- Land purchase.

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## 1. Overview

### 1.3 Peer Review Methodology

This Independent Peer Review report is intended to provide additional due diligence to confirm the adequacy of the McCowan Alignment - Footlong Station OME prepared by TTC and other documentation prepared by AECOM and Hatch.

The documentation was reviewed by our team to better understand the scope of the project and the basis for the assumptions in the estimates. Our review has been commensurate with the extent of the design work completed to date. TTC has made their best efforts to provide Hanscomb with all of the relevant and key information during our work.

Based on the design information received, we undertook to prepare our own OMEs where we could and comment where we could not easily estimate the scope based on our experiences and access to other TTC project data.

We also reviewed unit rates, general requirement and fees, contingencies, risk, escalation etc.

Under separate cover, we have provided TTC with our 'line by line' review in XLS & PDF format.

### 1.4 Procurement Model

We understand that the TTC OME assumes a traditional design bid build (DBB) method of procurement which is TTC's standard method for procuring its capital projects. Hanscomb recently participated as a cost estimating subject matter expert at a Value Engineering workshop facilitated by BT Engineering. It was noted at the workshop that the project may be delivered through a design build finance (DBF) model. This contracting strategy is currently under review along with the design bid build finance (DBBF) model to determine which model will fit best with this project. To date the procurement model has yet to be determined.

The implications of a selected procurement model go beyond the cost of the capital work, and may also affect the way the project is presented to market, the amount of design work undertaken before going to market, and the size and makeup of the TTC team managing and controlling the project.

We understand that the extent to which the selected procurement model's tender documentation will be performance based or highly prescriptive is not known at this time, but it is clear that the TTC must understand the selected procurement method's implications for the end product that TTC will operate and maintain for a century to come.

The decision making process regarding possible procurement models may lead to further studies related to value for money analyses and retained risks, etc. From what we understand in Ontario, value for money is often achieved on alternative finance projects (AFP) or public private partnerships (P3) models within the retained project risk cost element, with the construction costs, soft costs and financing costs being comparable between a DBB and a DB or DBF model.

As has been stated by others when describing AFP or P3 projects, the private sector's ability to better manage project risks and leverage design innovation has been widely discussed in the public realm.

## 2. Peer Review Findings

### 2.1 General

#### 2.1.1 Estimate Documentation

The TTC's OME was based on drawings prepared by AECOM and Hatch. For system wide elements, land acquisition, engineering and management, etc. the TTC has utilized previous project budget data in order to set these line item budgets.

The documentation listed below was used for the preparation of the TTC Order of Magnitude Estimate:

<b>Title of Documents Received</b>	<b>Dated</b> (DD/MM/YYYY)	<b>Received</b> (DD/MM/YYYY)
SSE OME Kennedy to Scarborough C.C.	22/07/2016	08/2016
McCowan At-Grade Concept Sketches 1-5	11/08/2016	17/08/2016
McCowan At-Grade Concept Sketches + Renderings 1-8	11/08/2016	17/08/2016
Technical Memo + Sketches 1-22	24/04/2016	17/08/2016
Tunnel Package Diagram	21/07/2016	17/08/2016

We have been careful to ensure that our review has been based on the same documentation used by TTC Estimating in generating the OME. To the best of the project team's ability, we are confident that this has been the case.

#### 2.1.2 Estimate Format

The TTC's OME was prepared in the traditional TTC Estimating cost breakdown structure format with the intention to provide a realistic allocation of costs, consistent with commonly accepted estimating principles for work of this nature and this stage of design progression. The TTC's OME addresses hard construction cost, equipment, land acquisition and soft costs.

The construction cost has separated the following orders:

- Scarborough Centre Subway Station, bus terminal and area facilities;
- Substation building
- Running structure including special structure
- Utilities (excludes stations area)
- System wide elements
- The soft cost has separated the following orders:
  - Project engineering and management allowances
  - Project contingency allowances
  - HST rebate
- Property acquisition, easements, legal fees etc.



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## 2. Peer Review Findings

### 2.1 General (Continued)

#### 2.1.2 Estimate Format (Continued)

- Scarborough Town Centre (STC) mall lost revenue impact
- Revenue vehicles
- Vehicle automatic train control ATC equipping allowance

This type of cost estimate breakdown is consistent with estimates that are developed at this stage of design and for this type of project.

#### 2.1.3 Project Specifications

We have not received any project specifications for this peer review and would not anticipate this document at this stage of design (2% to 5% complete documents). We understand that the TTC OME assumes strict adherence to the TTC Design Manual.

#### 2.1.4 Costs Provided by Others

The details of TTC's OME indicate that quantities, pricing, allowances etc. prepared by AECOM and Hatch have been validated and adjusted by TTC Estimating and provided to Hanscomb for Peer Review.

### 2.2 Review of Cost Elements

#### 2.2.1 Review Procedures

As part of our review, the following exercise was undertaken:

- Item description and accompanying unit rate were reviewed for general consistency with current market condition as of 2015;
- OMEs were prepared for the station box, bus terminal and site development including roads, bridges and utilities;
- Tunnel totals in terms of their costs per running metre were reviewed for consistency based on input from TTC Estimating and Hatch. We understand that Hatch has a good track record when comparing their estimates to project award amounts;
- The total cost of special structures such as vent shaft, extraction shaft, launch shaft, working shaft and emergency exit buildings (EEBs) was reviewed for consistency based on our experience with previous similar projects; and
- Substation total costs were reviewed for consistency based on our experience with previous similar projects.

Arithmetic and formulas were checked. Quantity and unit rate extension and page totals were checked and found to be arithmetically accurate.

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## **2. Peer Review Findings**

### **2.2 Review of Cost Elements (Continued)**

#### **2.2.2 Scarborough City Centre Subway Station Box**

Hanscomb prepared an order of magnitude estimate comparable to TTC's OME using the same design documentation for this project element. Hanscomb's estimate is in the order of 6% lower than TTC's OME. This variance is in order of minus \$10 million.

We also carried out 'spot checks' on the major cost items such as on excavation, shoring and concrete and found our quantities to be close to those listed in TTC's OME.

#### **2.2.3 Scarborough City Centre Bus Terminal**

Hanscomb prepared an OME comparable to TTC's OME using the same design documentation for this project element. Hanscomb's estimate is in the order 8.5% lower than TTC's OME. The variance is in the order of minus \$7.7 million.

This variance is mainly attributable to mechanical and electrical component costs. We have noticed that TTC's OME is carrying high unit rates on a gross floor area (GFA) basis for the outdoor bus platform and driveway for both mechanical and electrical disciplines. We recommend that the unit rates be reviewed. Our perception is that the mechanical and electrical scope of work for the outdoor scope is not as extensive as the unit rates would suggest.

#### **2.2.4 Site Development including Road and Bridge**

Hanscomb prepared an OME comparable to TTC's OME using the same design documentation for this project element. Hanscomb's estimate is in the same order of costs as TTC's OME.

#### **2.2.5 Architectural Excellence**

The impact of architectural excellence is highly subjective if this project is to include this as a mandated enhancement, and as such this item should be reviewed further. We have seen cost impacts for architectural excellence well in excess of \$5 million on station projects. We understand that this budget line item is for the enhancement of architectural finishes only and not for any other kind of design enhancement. For the purposes of this review, we believe that this allowance is reasonable.

#### **2.2.6 Green LEED Sustainability**

We understand that the Project is to meet Tier 1 of the Toronto Green Standard and includes a green or cool roof, storm water management, and minor landscaping items. We feel this allowance is reasonable.

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## **2. Peer Review Findings**

### **2.2 Review of Cost Elements (Continued)**

#### **2.2.7 Station Artwork**

This \$0.5 million allowance appears to be the standard for TTC's budget allowance for new station. In our opinion this allowance seems reasonable assuming the status quo and nothing more is required or provided; however, we have carried higher costs for other TTC subway projects that we have worked on. For the purposes of our review, we are adding \$0.5 million to this line item.

#### **2.2.8 Station Area Utilities and Traffic Control**

Hanscomb prepared an OME comparable to TTC's OME using the same design documentation for this project element. Hanscomb's estimate is in the same order of costs as TTC's OME.

#### **2.2.9 Escalators and Elevators**

We have reviewed the AECOM's escalators and elevators quantity table and agreed the quantity of escalators and elevators noted in TTC's OME estimate are correct.

The unit rates appear to be reasonable for both items noted above.

We understand that the elevators are anticipated to be high passenger capacity and may not be required to meet TTC's Design Manual.

#### **2.2.10 Substation Buildings**

TTC's OME includes 3 No. substation buildings and we have not received any details of this estimate line item. We have noticed that two substation buildings are standard sized (approximately 600 m<sup>2</sup>) and the other is non-standard (much larger GFA and below grade). The budgets carried for these buildings seem reasonable.

Furthermore, the AECOM drawings for the non-standard substation building indicate a larger gross floor area than TTC has estimated. This discrepancy may impact the cost. For the purposes of our review, we have added additional \$1 million against this budget line item.

## 2. Peer Review Findings

### 2.2 Review of Cost Elements (Continued)

#### 2.2.11 Running Structure Including Tunneling and Special Structure

Table 3: Hanscomb has summarized the TTC's running structure

	TBM Purchase/Sell	Tunnel Structure	Launch Shaft	Extraction Shaft	Working Shaft	EEB	Total
TBM							
Purchase/Sell	\$56,357,365	\$0	\$0	\$0	\$0	\$0	\$56,357,365
Tunnel Structure	\$0	\$455,117,572	\$0	\$0	\$0	\$0	\$455,117,572
Launch Shaft	\$0	\$0	\$57,561,982	\$0	\$0	\$0	\$57,561,982
Extraction Shaft	\$0	\$0	\$0	\$13,308,916	\$0	\$0	\$13,308,916
Working Shaft	\$0	\$0	\$0	\$0	\$7,463,722	\$0	\$7,463,722
EEB	\$0	\$0	\$0	\$0	\$0	\$91,841,518	\$91,841,518
<b>Total Construction Cost</b>	<b>\$56,357,365</b>	<b>\$455,117,572</b>	<b>\$57,561,982</b>	<b>\$13,308,916</b>	<b>\$7,463,722</b>	<b>\$91,841,518</b>	<b>\$681,651,075</b>

Based on our best judgment, we have reviewed the overall cost of the tunnel on a track metre basis, and we feel that the unit rate is reasonable based on the input from TTC and Hatch.

The net purchase cost for the TBMs is around \$56 million. It is our understanding that this budget is based on a quote from a German vendor sourced by Hatch. Hanscomb has not received this quote for review purposes. We assume that it is reasonable. We recommend that TTC verify this quote.

The special structures include launch shafts, extraction shafts, working shafts and EEBs. Our review indicated that the shafts were in line with what we would expect based on our previous experience for similar projects.

We understand that the Toronto area has lost its local tunnel boring machine (TBM) manufacturer to the vagaries of the market. The loss of this local bidder may affect the overall bidding pool and competitive nature of the purchase line item within the budget. For the purposes of our review, we have not adjusted this line item.

The EEB's, however, tend to have been estimated on the high side. We would normally expect EEBs to be in the region of \$3 million each. However, based on our discussions with the TTC Estimating team and our review of the documentation, it was pointed out that the depth of buildings is reaching approximately 40m below grade. This is a consequential depth and will definitely have an impact on the costs of the EEBs. In that respect, we would concur that the rationale of carrying over \$7 million for each EEB is reasonable.

EEB #4 is combined with a fire ventilation fan plant and therefore it is larger and more complex than a typical single purpose EEB's. Factoring for the complexity and the combined purpose, we believe that the cost carried appears to be reasonable.

#### 2.2.12 Utilities (along Running Structure)

Hanscomb has not received the estimating details for these line items. This allowance should be reviewed as they seem driven by higher per dual track metre (DTM) cost (and not by scope). For the purpose of this review Hanscomb has doubled the rate of this item. The added cost is plus \$10.94 million. .

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## **2. Peer Review Findings**

### **2.2 Review of Cost Elements (Continued)**

#### **2.2.13 System Wide Elements**

The system wide elements include the track work, power supplies to the tunnels, signals, SCADA, RTU's, subway antenna, NA, Intercom, CCTV, etc.

We feel these allowances are reasonable and have been calculated based available TYSSE rates.

### **2.3 Review of Soft Costs**

#### **2.3.1 Project Engineering and Management**

The TTC's OME includes 25% of the hard construction costs for the Project Engineering and Management. This percentage seems to be reasonable based on other large capital projects that we work on regularly assuming a DBB method procurement.

As we noted above, the TTC budget is based on a DBB procurement approach. If the project proceeds through a different procurement model, we suggest that this line item be reviewed and modified as necessary to suit the chosen model. It is possible that the private sector, through a DB or DBF model, may deliver and leverage economies against the scope of this line item

#### **2.3.2 Project Contingency**

Hanscomb recommends that this general project contingency be segregated into design and pricing and post-contract contingency (change orders and claims). We understand that TTC is reviewing project risks separately. We understand that the 30% currently being carried is roughly split between the above items in the following way: 25% design evolution and 5% for post-contract changes and claims. The overall percentage of 30% seems reasonable and appropriate for this stage of the project development (2% to 5% complete documents) if 100% complete and coordinated documentation is issued for tender and construction.

Budgets are set assuming that the scope will not change and cannot easily absorb scope creep. TTC may wish to institute a management reserve fund approach where a general project contingency is maintained to cover some scope creep items at the approval of the Executive. For other large capital projects, we have often recommended a reserve of 5 to 7.5% of the bottom line amount. Scope changes beyond 5 to 7.5% should be funded by additional budget injections. For this review purpose, Hanscomb added 7.5% of the construction value for further discussion.

Construction budgets are set assuming that tender documentation will be 100% complete and fully coordinated at the time of tender. If the tender documentation is not as assumed, the value of change orders and claims will likely exceed the 5% allowed as noted above. For this review purpose, Hanscomb has carried an additional 2.5% of the construction value.

## **2. Peer Review Findings**

### **2.3 Review of Soft Costs (Continued)**

#### **2.3.3 Property Acquisition, Easements, Legal Fees, etc.**

Property acquisition and easements are calculated based on a percentage of 5.6% on the project costs inclusive of contingencies and engineering and management costs. TTC Estimating has provided some track records costs for other TTC subway extension projects and the carried percentage compares well. For the purposes of our review, we have not made any adjustment to this budget line item.

#### **2.3.4 STC Mall Lost Revenue Impact**

A lump sum of \$1 million has been allocated for Scarborough Town Centre mall's loss of revenue that may potentially arise from construction disturbances. As per the estimate's notes, this appears to be an agreed upon value between all parties concerned. Without further details, we are unable to provide our comments on whether the number is reasonable or not. For the purposes of this review, we have included a variance of plus \$4 million against this line item.

#### **2.3.5 Revenue Vehicle and ATC Equipping**

This line item appears reasonable based on other TTC projects that we have seen.